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Abstract

The purpose of this letter is to analyze the impact of economic integration on capital accumulation and capital flows when countries differ in their social security systems, especially as regards the degree of funding of pensions and the regulation of the retirement age. Funding and early retirement both foster capital accumulation relative to pay-as-you-go pensions with flexible retirement. In the case of economic integration, both imply capital outflow possibly resulting in utility losses.

Keywords: economic union, pension, retirement age, social security.

JEL classification: H2, F42, J26.

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1 Introduction

It is a well known fact that economic integration can have unpleasant implications for countries which are relatively less indebted than others. Whether the debt concerned is the traditional sovereign debt or that which is implicit to unfunded pension schemes, free capital mobility leads to capital outflow from countries enjoying sound public finances to indebted ones. This consideration justified the criteria set out in the Maastricht Treaty of the European Union: a deficit of less than 3% and a debt to GDP ratio not exceeding 60%. Interestingly, the Maastricht Treaty did not consider the other –less explicit– forms of indebtedness. For, beside indebtedness, there are other national characteristics having similar implications but getting less attention. One of these is the degree of flexibility regarding the retirement age. There exist a wide variety of regulations concerning retirement across OECD countries¹ resulting in significant variation in the effective age of retirement². This situation has implications as regards saving and capital accumulation. The life cycle theory of saving is explicit enough: the later individuals retire, the less they have to save. Someone willing and allowed to work till the end of his life will need to save much less than someone either induced or forced to retire around 55, which is frequently the case in countries such as France or Belgium.

This paper examines the role of two features of retirement systems with regard to economic integration: whether pension is funded or not and whether it comprises flexible or early retirement age. The impact of funding has been widely studied³. It is largely equivalent to that of public debt in an economic union. On the other hand, the effect of early versus flexible retirement has received little attention in the literature. Using an overlapping generations model (OLG) in the steady state, we show that 1) early retirement incites individuals to save more for their old age and 2) both a PAYG pension system and a flexible retirement age imply an inflow of capital from countries with fully funded pensions and early retirement. As the contrast between early and flexible retirement is at the heart of this letter, a word of explanation is in order at the outset. One generally distinguishes three definitions for the retirement age: the optimal or flexible age –which is the age at which individuals would choose to retire if they were subject to no distortion–, the statutory age (also called pensionable age) –which is the age at which they are expected or required to cease work and become entitled to full pension benefits–, and last, the effective age of retirement –which generally is below both the statutory and the optimal age

¹See Fenge and Pestieau (2005).

²Gruber and Wise (1998).

³See Casarico (2001), Adema *et al.* (2009, 2010).

of retirement. As argued by Gruber and Wise (1998, 2004), people are induced to retire before the optimal and statutory age through an array of incentives working out as an implicit tax on prolonged activity. In what follows, the terms (induced) early age and effective age are used indifferently as this age is the result of explicit policies aimed at lowering the age of retirement relative to the statutory level. In most countries studied by Gruber and Wise⁴, the statutory age of retirement is 65 while the effective age is far below that. Using the implicit tax which they estimate for each country yields a rough idea of the optimal age of retirement. As long as the implicit tax is positive, one knows that the effective age, which we call the early age of retirement, is below the optimal age of retirement⁵.

2 The basic model: autarky

We use the standard overlapping generations model. An individual belonging to generation t lives two periods t and $t + 1$. The first one has a unitary length while the second has a length $\ell \leq 1$, where ℓ reflects variable longevity. In the first period, the individual works and earns w_t which is devoted to the first-period consumption, c_t , saving s_t and the lump-sum pension contribution τ . In the second period he chooses an amount of labor time $z_{t+1} \leq \ell \leq 1$ and earns $z_{t+1}w_{t+1}$. This earning plus the proceeds of saving $R_{t+1}s_t$ and the PAYG pension p finance second period consumption d_{t+1} . Working z_{t+1} implies a monetary disutility $v(z_{t+1}, \ell)$ where $\frac{\partial v}{\partial \ell} < 0$ reflects the idea that an increase in longevity fosters later retirement. The parameter τ measures the relative size of the unfunded pensions. In other words, $\tau = 0$ implies that the whole pension system is funded.

For simplicity's sake, we use simple functional forms : logarithmic utility for c and d and quadratic disutility for z : $z^2/2\gamma\ell$, where γ is a preference parameter. We can now write the problem of the individual belonging to generation t . It amounts to maximize:

$$U_t = \ln(w_t - \tau - s_t) + \beta\ell \ln\left(\frac{R_{t+1}s_t + w_{t+1}z_{t+1} - z_{t+1}^2/2\gamma\ell + p_{t+1}}{\ell}\right) \quad (1)$$

where $p_t = \tau(1 + n)$ ⁶. The FOC's with respect to z_{t+1} and s_t yield

⁴See also OECD (2011).

⁵In a full-fledged model the implicit tax inducing early retirement should have been explicitly specified as in Fenge and Pestieau (2005). This would have made the presentation unnecessarily complicated.

⁶We thus assume defined contributions.

$$z_{t+1} = z_{t+1}^* = \gamma \ell w_{t+1} \quad (2)$$

$$s_t = \frac{\beta \ell}{1 + \beta \ell} w_t - \frac{\gamma \ell w_{t+1}^2}{2 R_{t+1} (1 + \beta \ell)} - \tau \left(\frac{\beta \ell}{1 + \beta \ell} + \frac{1 + n}{(1 + \beta \ell) R_{t+1}} \right) \quad (3)$$

Alternatively, we can have an induced early age of retirement \bar{z} , with $\bar{z} < z_{t+1}^*$, i.e. workers are made to work less than they would choose with perfect flexibility. In this case, we rewrite equations (2) and (3) as follows:

$$z_{t+1} = \bar{z} \quad (4)$$

$$s_t = \frac{\beta \ell}{1 + \beta \ell} w_t - \frac{\bar{z}}{R_{t+1} (1 + \beta \ell)} (w_{t+1} - \bar{z}/2\gamma \ell) - \tau \left(\frac{\beta \ell}{1 + \beta \ell} + \frac{1 + n}{(1 + \beta \ell) R_{t+1}} \right) \quad (5)$$

We now turn to the production side. We use a Cobb-Douglas production function

$$Y_t = F(K_t L_t) = A K_t^\alpha L_t^{1-\alpha} \quad (6)$$

where the labor force is $L_t = N_t + N_{t-1} z_t = N_{t-1} (1 + n + z_t)$, K_t is the stock of capital and A is a productivity parameter. We distinguish L_t the labor force and N_t the size of generation t . We assume that

$$N_t = N_{t-1} (1 + n)$$

where n is the fertility rate. Denoting $K_t/L_t \equiv k_t$ and $Y_t/L_t \equiv y_t$, we obtain the income per worker (and not per capita):

$$y_t = f(k_t) = A k_t^\alpha,$$

and the factor prices

$$\begin{aligned} R_t &= A \alpha k_t^{\alpha-1} \\ w_t &= (1 - \alpha) A k_t^\alpha \end{aligned}$$

The equilibrium conditions in the labor and capital markets are respectively

$$\begin{aligned} L_t &= N_{t-1} (1 + n + z_t) \\ K_{t+1} &= N_t s_t \end{aligned}$$

We can now write the dynamic equation with perfect foresight for the capital accumulation when z is chosen optimally:

$$(1 + n + z_{t+1}) k_{t+1} = s_t \quad (7)$$

i.e.,

$$(1+n)k_{t+1} + \gamma\ell A(1-\alpha)k_{t+1}^{\alpha+1} = \frac{\beta\ell}{1+\beta\ell}A(1-\alpha)k_t^\alpha - \frac{\gamma\ell k_{t+1}^{1+\alpha}A^2(1-\alpha)^2}{2(1+\beta\ell)A\alpha} - \tau\left(\frac{\beta\ell}{1+\beta\ell} + \frac{(1+n)k_{t+1}^{1-\alpha}}{A\alpha(1+\beta\ell)}\right) \quad (8)$$

When $z = \bar{z}$, the dynamic equation becomes

$$(1+n+\bar{z})k_{t+1} = \frac{\beta\ell}{1+\beta\ell}A(1-\alpha)k_t^\alpha - \frac{\bar{z}k_{t+1}^{1-\alpha}}{(1+\beta\ell)A\alpha}(A(1-\alpha)k_{t+1}^\alpha - \bar{z}/2\gamma\ell) - \tau\left(\frac{\beta\ell}{1+\beta\ell} + \frac{(1+n)k_{t+1}^{1-\alpha}}{A\alpha(1+\beta\ell)}\right) \quad (9)$$

We can rewrite respectively (??) and (??) as:

$$G_t^1 = 2A\alpha(\ell^{-1} + \beta)(1+n)k_{t+1} - 2A^2\alpha\beta(1-\alpha)k_t^\alpha + 2\ell^{-1}\tau(1+n)k_{t+1}^{1-\alpha} + 2A^2\gamma\alpha(1+\ell\beta)(1-\alpha)k_{t+1}^{1+\alpha} + \gamma A^2(1-\alpha)^2k_{t+1}^{\alpha+1} + 2A\alpha\tau\beta = 0 \quad (10)$$

$$G_t^2 = A\alpha(1+\beta\ell)(1+n+\bar{z})k_{t+1} - \alpha\beta\ell A^2(1-\alpha)k_t^\alpha + \bar{z}k_{t+1}^{1-\alpha}(A(1-\alpha)k_{t+1}^\alpha - \frac{\bar{z}}{2\gamma\ell}) + \tau(\beta\ell A\alpha + (1+n)k_{t+1}^{1-\alpha}) = 0 \quad (11)$$

where G^1 and G^2 are implicit functions of k_t, k_{t+1} with z^* and \bar{z} respectively. Stability and unicity imply $0 < -\frac{\frac{\partial G^h}{\partial k_t}}{\frac{\partial G^h}{\partial k_{t+1}}} < 1$, with $h = 1, 2$, which in the steady state yields $G_k^h \equiv \frac{\partial G^h}{\partial k} > 0$. Differentiating totally (??) and (??) in the steady state and assuming both stability and unicity of k , we can show:

$$\frac{dk}{d\tau} < 0, \quad \frac{dk}{d\gamma} < 0, \quad \frac{dk}{dn} < 0.$$

These three inequalities are standard. It is indeed well-known that a PAYG pension (τ) depresses capital accumulation, that working longer (γ) has a negative impact on saving and that a lower fertility rate (n) increases the steady-state capital stock⁷. However, the effect of an increase in longevity on capital accumulation is ambiguous. Knowing that $G_k^h > 0$ we obtain indeed:

⁷At least with defined contributions pensions. See Artige *et al.*(2013) where defined contributions and defined benefits systems are compared.

$$\left. \frac{dk}{d\ell} \right|_{z=z^*} = \frac{2k}{G_k^1} [A\ell^{-2}\alpha(1+n) + \tau\ell^{-2}(1+n)k^{-\alpha} - A^2\alpha\beta\gamma(1-\alpha)k^\alpha] \geq 0 \quad (12)$$

$$\left. \frac{dk}{d\ell} \right|_{z=\bar{z}} = \frac{A\alpha\beta}{G_k^2} [A(1-\alpha)k^\alpha - (1+n+\bar{z})k - \frac{\bar{z}^2 k^{1-\alpha}}{2A\alpha\beta\gamma\ell} - \tau] \geq 0 \quad (13)$$

The ambiguity of $\frac{dk}{d\ell}$ depends on second-period activity along with a PAYG system⁸.

At this point, a number of comments are in order. Splitting the second period into a subperiod of work and one of retirement with the possibility of choosing the age of retirement in an overlapping generations model goes back to Hu (1979) and later to Michel and Pestieau (2003). That an induced early age of retirement fosters saving for those who would have chosen to work later was mentioned by Feldstein (1974) in one of his seminal papers on social security. In this letter, payroll taxation only applies to first-period earnings so as to simplify the presentation. A proportional tax on second-period earnings would have a downward distortive effect on the age of retirement. Our purpose is to contrast two systems: one with early retirement, which could be induced by a prohibitive implicit tax, and one with free and undistorted choice of retirement age.

Finally, it is important to note that some of these results, particularly the unambiguous comparative statics, comes from our particular specification of preferences and technology. As de la Croix and Michel (2002) showed, departing from the Cobb-Douglas specification results in problems of unicity and stability.

3 Economic union

Let us assume that we have m ($i = 1, \dots, m$) countries being identical in all respects but the flexibility of retirement choice ($z = z^*$ or \bar{z}) and the degree of unfunding of their pension system (τ). The utility of country i at time t is equal to

$$U_{i,t} = \ln(w_{i,t} - \tau_i - s_{i,t}) + \beta\ell \ln \left(\frac{w_{i,t+1}z_{i,t+1} + R_{i,t+1}s_{i,t} - (z_{i,t+1})^2/2\gamma\ell + \tau_i(1+n)}{\ell} \right)$$

where $z_{i,t+1}$ is equal to \bar{z}_i or to $\gamma\ell w_{i,t+1}$ depending on the age of retirement in country i . In autarky and in the steady state, R_i and w_i depend on s_i such as defined in the previous section. Let us now open borders and allow for capital mobility. At the equilibrium, we need the same R_t and w_t everywhere. This means that, at the

⁸Note however from (12) that with $z = z^* = 0$, there is no ambiguity.

open-economy equilibrium, countries with relatively high interest rates in autarky will enjoy some capital inflow from countries with low interest rates in autarky. The equilibrium in the international capital market is given by:

$$N_t \sum_{i=1}^m s_{i,t} = \sum_{i=1}^m K_{i,t+1} \quad (14)$$

Perfect mobility in the international capital market implies:

$$R_{i,t} = R_t \quad (15)$$

and hence, $k_{i,t} = k_t \quad \forall i$, and for all t after economic integration. The open-economy steady-state k is the solution to

$$\sum_{i=1}^m G_i = \sum_{i=1}^m [(1 + n + z_i)k - s_i(k)] = 0 \quad (16)$$

where $z_i = z_i^*(k)$ or \bar{z}_i . Each country i is assumed to be identical except for the value of τ and the existence of \bar{z}_i . Both z_i and s_i are defined by (??) and (8) if $z_i = z_i^*$ or (4) and (9) if $z_i = \bar{z}_i$.

For the sake of presentation, we distinguish among four types of countries with subscript F for funded and P for unfunded, and another subscript E for early retirement, and O for optimal retirement. Thus we have: PE, PO, FE, FO. In autarky we expect the following ranking in terms of capital:

$$k_{FE} > k_{PE} \geq k_{FO} > k_{PO}$$

Whereas the extreme cases for k are not ambiguous, the intermediate cases are. Their ranking will depend on the size of τ and the gap between \bar{z} and z^* . If the gap between the optimal and the early retirement age is small and if the PAYG pension is large, one expects to have $k_{PE} < k_{FO}$. The comparison of utility levels is not immediate. Throughout the paper, we assume dynamic efficiency ($r > n$). This implies that early retirement can yield more steady-state welfare than optimal retirement for either a funded or an unfunded pension if the "static" inefficiency it entails is small relative to its boosting of capital accumulation. This boost brings the economy closer to the Golden Rule ($r = n$).

With capital mobility, we have, in the steady state, a uniform value of k with an outflow from the high-saving countries to the low-saving ones. The overall utility does increase. Yet some countries can experience a loss in utility. To go further, we use a numerical example. Before proceeding, though, it is important to note that

we posit that each member country entering the economic union is characterized by a given social security policy that will not change throughout the process of integration. We want to see the incidence of capital mobility on the level of saving, the labor supply and the utility of countries with different but given social security systems. Our paper is at odds with a number of studies that consider the game among countries looking for the optimal design of their social security system in a setting of factor mobility and strategic interaction. The design can rest on social welfare maximization or on voting in each country and the standard result is the so-called race to the bottom⁹. Here we take the social security systems as given and look at the effect of opening borders on capital accumulation and welfare. As there is no strategic dimension in our analysis, the number of countries involved does not matter. In this respect, we are in line with Casarico (2001) and Adema *et al.* (2009, 2010), who focus on differences in funding and not in retirement policy, which is the specific contribution of this letter.

We here consider a setting with four types. The two more noticeable types are FO and PE. Indeed, the association of PAYG pensions and early retirement on the one hand, and the association of flexible retirement and full funding on the other, are often observed and contrasted. For example, according to EC (2013), the share of PAYG pensions in GDP and the effective age of retirement respectively were 7.7% and 63.5 in the UK, 7.5% and 64.9 in Ireland but 14.6% and 60.1 in France, 15.3% and 61.3 in Italy. The former two countries correspond to the type FO and the latter two to the type PE. As we have shown regarding such social security systems, it is not easy to determine which countries may benefit from an economic union without looking closely into their system.

4 Numerical examples.

In our simulations, we use the same specification as above with: $y_t = Ak_t^\alpha$ where $A = 50$ and $\alpha = 1/3$. As to preferences, $\beta = 1$ and $\gamma = 0.005$. The demographic parameter values are given by $n = 0.05$ and $\ell = 0.9$. Finally the policy instruments are $\tau = 10$, $\bar{z} = 0.2$. We assume that we have the same number of countries of each type.

Insert Table 1

Table 1 gives the capital stock and welfare that prevail in autarky and in the steady state. The values obtained correspond to the theoretical expectations: early retirement and fully funded pensions imply the highest capital stock and optimal

⁹See Cremer and Pestieau (2004).

retirement with PAYG the lowest. Flexible retirement along with fully funded pensions yield the highest welfare while optimal retirement with PAYG yield the lowest. Naturally, the cases that were theoretically ambiguous can now be ranked.

Tables 2 presents the key results when capital is allowed to move freely. Two important findings: the overall welfare increases ($\Delta U > 0$) while overall capital accumulation decreases ($k < \bar{k}_{aut}$). Individually, countries which experience an outflow of capital also have a loss in welfare. Besides, we observe some symmetry in outflows and inflows of capital. For example, the inflow of capital from FE is equal to the inflow in PO; this is due to the linear structure of the saving function. To sum up, we observe that in aggregate terms countries benefit from capital mobility; yet, those exporting capital lose out and those importing capital benefit from economic integration.

Insert Table 2

5 Conclusion

The objective of this paper was to study the effects of different social security systems on capital accumulation and capital flows for countries forming an economic union. We have chosen a simple setting in which countries differ in the structure of their pension system with a focus on two key dimensions: funding and the age of retirement. The first dimension has been widely discussed in the literature. As for the second one, it has rarely been acknowledged that early retirement could induce more capital accumulation than flexible retirement and thus compensate for the depressive effects of PAYG pensions on saving. In a setting with international capital mobility, the consequence is that, *ceteris paribus*, capital will flow from countries with early retirement to those with flexible retirement. The effects on welfare are, as is usual in an OLG model, ambiguous. In our numerical example, only the economy with full funding and early retirement exhibits a welfare loss when capital markets integrate. These findings are only relevant for the steady-state. Results are likely to differ in the short-run dynamics. From a policy viewpoint, the main implications of this letter lead to qualifying the debate on the cost and the benefit of forming an economic union. Up to now, the emphasis has been put on the level of a country's explicit and implicit indebtment including the extent to which its social security is unfunded. What we show here is that early retirement can partly compensate for the PAYG negative effect on saving¹⁰.

¹⁰Naturally the compensation is only partial. We should also keep in mind that to achieve the first best one needs flexible retirement along with an intergenerational transfer that leads to the

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(modified) golden rule.

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Table 1: Autarky

	FE	FO	PE	PO
k	37.14	27.34	28.59	21.76
U	8.28	8.30	8.14	8.15
$\bar{k}_{aut} = 28.708$				

Table 2: Open Economy

	FE	FO	PE	PO	Average
U	8.24	8.31	8.16	8.23	8.23
ΔU	-0.04	0.01	0.02	0.08	0.017
$(1 + n + z)k - s$	-8.48	0.69	-0.69	8.48	0
$k = 27.84; \bar{z} = 0.2; z^* = 0.4546$					

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